# CHAPTER 2. REVIEW OF FALSEWORK DRAWINGS

## 2-1.01 Introduction

This chapter covers Division of Structures policy with respect to the falsework drawing review process. Subsequent chapters cover specific review guidelines, procedures and explanations where necessary to ensure uniform and impartial contract administration.

As noted in Chapter 1, review and approval of the contractor's falsework design is delegated to the Office of Structure Construction's structure representative in responsible charge of structure work at the project site. And while the actual design check may be performed by any qualified member of his staff, the structure representative is expected to give his personal attention to the review while it is in progress and to give his concurrence before the drawings are approved.

## 2-l.02 General Information

The contract requirement for submission of falsework drawings. should be discussed at the preconstruction conference, with emphasis on the need for a complete submittal before the review period begins. (See Section 2-1.04 for information that must be shown in a "complete" submittal.) The contractor should be reminded that, except for foundation pads and piles, falsework construction may not begin until the drawings are approved.

When a manufactured product or assembly will be used, the specifications require the contractor to furnish catalog data or other descriptive literature showing the manufacturer's recommended safe load-carrying capacity, conditions of use, and other information affecting the ability of the particular product or device to carry the design load. However, such supplemental design information must be furnished only if it is requested by the engineer. To avoid delaying the review while waiting for supplemental information, the contractor should be informed promptly in any case where required technical data is not furnished when the drawings are submitted for review.

It is not necessary for the contractor to submit all drawings that will be required eventually before any are reviewed. The drawings may be submitted in increments, and the increments may be approved, provided they are well-defined units of the work, such as individual bridges or portions of bridges that are independent of other portions.

If falsework plans for different units of the work (two or more individual bridges, for example) are submitted at the same time, or if an additional plan is submitted for review before review of a previously submitted plan has been completed, the contractor must designate the order or sequence in which the

plans are to be reviewed. The time allowed for the review of any plan in the sequence is not less than the contract time allowed for review of that plan, plus two weeks for each higher priority plan still under review.

On most contracts the engineer will be allowed three weeks for review of the falsework drawings. For complicated structures or if railroad approval will be required, the contract special provisions will establish a longer review period.

Omissions, inconsistencies and design deficiencies discovered during any review should be noted in red on the drawings, and one set of drawings returned to the contractor for correction and resubmission.

When falsework drawings are returned for correction, they are to be accompanied by a letter giving the reason or reasons the drawings are not acceptable, The letter should list the specific deficiencies found (i.e., 6x16 stringers overstressed in bending) but elaboration is unnecessary. Do not suggest any corrective measures; listing the deficiencies is sufficient.

2-1.03 Design Calculations

In addition to falsework drawings, the contractor must furnish a copy of the design calculations.

The specifications require the design calculations to show the stresses and deflections in load-supporting members. In the specification context, the term "load-supporting members" will be construed as meaning the design-controlling members. It is not the specification's intent to require the contractor to calculate the stress in, and the deflection of, each and every member in the falsework system.

Keep in mind that the design calculations furnished by the contractor are for information only; they are not for review and approval. Accordingly, any design or construction details which may be shown in the form of sketches on calculation sheetsmust be shown on the falsework drawings as well; otherwise the drawings will not be complete. Note that as a matter of Division policy, falsework drawings are not to be approved in any case where it is necessary to refer to calculation sheets for information needed to complete the design review, or where information shown only on the calculation sheets will be needed for construction.

In most cases it is unnecessary to refer to the contractor's calculations during the design review. However, in the event a falsework member is overstressed or is otherwise inadequate in some respect, reference to the calculations may reveal the reason for the design deficiency.

## 2-1.04 Initial Review

Immediately upon receipt of the first submittal of any set of falsework drawings, the engineer will make an Initial review of the documents received. The purpose of the initial review is to ascertain whether the drawings and any required supporting data are "complete" within the meaning of this term as it is used in the Standard Specifications.

Determining whether a particular submittal is complete, or is not complete, involves a certain degree of subjectivity, and the engineer will be expected to exercise judgment and common sense when making this determination. The basic requisite is that the drawings contain enough information to enable the engineer to verify that the design meets contract requirements. This is accomplished by making a stress analysis; therefore, if there isn't enough information or detail to make a stress analysis, the drawings are not complete.

While Division policy requires a "complete" falsework submittal to contain enough information to enable the-engineer to verify the adequacy of the falsework design, this does not mean that every design detail must be shown on a given set of falsework drawings. A reference to a standard plan submitted previously, or to a previously submitted drawing for another structure in the same contract having a similar detail, is acceptable. [1]

Regardless of other considerations, for administrative purposes the drawings will be viewed as incomplete (and will be returned to the contractor for completion and resubmission) if <u>any</u> of the following information is omitted:

The drawings must show the size of all load-supporting members, including soffit joists, and all transverse and longitudinal bracing, including connections. For box girder structures, the drawings must show the falsework members supporting sloping exterior girders, deck overhangs and any attached construction, walkways.

All design-controlling dimensions must be shown, including beam length and spacing; post location and spacing; overall height of falsework bents; vertical distance between connectors in diagonal bracing; and similar dimensions that are critical to the design.

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[1] Standard plans and Standard details are to be reviewed and approved in the same manner as other falsework drawings, even though they may have been approved on a previous contract. Once approved, however, they need not be again reviewed when included withfalsework drawing submittals for subsequent structures in the same contract.

- The location and method by which the falsework will be adjusted to final grade must be shown.
- Unless a concrete placing schedule is shown on the plans, the falsework drawings must include a superstructure placing diagram showing the proposed concrete placing sequence and/or the direction of pour, whichever one is applicable, and the location of all construction joints. (For relatively simple structures, this requirement may be satisfied by a note on the drawings.)
- The drawings must show all openings through the falsework. Horizontal and vertical clearances must be clearly shown, and must meet contract requirements. The location of temporary K-rail must be shown.
- If the falsework will incorporate a proprietary shoring system, the trade name and rating (i.e., WACO 100 kip steel shoring) must be shown.
- If the height of the falsework at any location, measured from the ground line to the bridge soffit, exceeds 14 feet, or if any falsework span exceeds 16 feet, or if openings are provided for vehicular, pedestrian or rail-road traffic, each sheet of the drawings must be signed by a civil engineer registered in California. (This includes standard plans and standard details.)
- The drawings must be accompanied by the contractor's design calculations; and any other supplemental data required by the falsework design that is needed for a stress analysis. [2]

Division policy requires the initial review to be completed within two working days following receipt of a given set of falsework drawings. The purpose of this policy is to assure a timely notice to the contractor in the event the drawings are not complete. Since the only purpose of the initial review is to discover omissions that would prevent completion of a

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[2] The specifications require the contractor to submit design data for any manufactured assembly to be used in the falsework, but only if requested by the engineer. To assure a complete falsework design submittal and thus avoid any unnecessary delay in the review process when a manufactured product or device will be used, the specification requirement should be discussed with the contractor at the preconstruction conference. The contractor should be informed that if proprietary products of any kind are to be used, the required technical data must accompany the falsework drawings when they are first submitted for review.

subsequent design check, neither calculations nor an evaluation of design details is required; thus completion within 2 working days is a realistic time frame.

When reviewing falsework drawings pursuant to instructions in this section, keep in mind that submission of complete drawings along with all required supporting data is a specific contract requirement that controls the start of the falsework review period. However, while the time period for review of falsework drawings does not begin until a complete submittal is received, it is often possible to review portions of the design which do not depend on the missing information. Accordingly, it is Division policy to expedite the approval process by reviewing as much of the design as is possible while waiting for the resubmittal of falsework drawings that have been returned for completion following the initial review.

The initial review may reveal omissions which are not of such serious consequence as to delay the design check, but which if not corrected will delay approval. For example, the omission of items such as the falsework erection and removal plan; pad and/or pile design information; the falsework lighting plan, if one is required; and similar information that will eventually be required prior to approval should be brought to the contractor's attention at the earliest convenient time.

2-1.05 Determining Review Durations

As previously noted, the time allowed by the contract for the engineer's falsework design review is three weeks, or more for complicated structures or when railroad approval is required.

Regardless of the time allowed, the review period begins when a complete set of drawings is received from the contractor, and ends when the drawings are approved. However, the total elapsed time between submission of complete drawings and final approval may exceed the time properly attributable to the engineer's review. This is the case because the engineer is not responsible for time taken by the contractor to make necessary revisions or corrections to the drawings.

Determining the actual duration of the engineer's review can be critical from an administrative standpoint, since the contract provides for additional time and compensation to offset any time lost due to delays attributable to the engineer's failure to complete the falsework review within the time allowed. [3]

[3] In the event the contractor is delayed, the additional time and compensation due are determined in accordance with the Right of Way Delay provisions of the contract.

## 2-1.05A The Falsework Review Clock

Conceptually, the duration of the engineer's review may be visualized as the time elapsed on an imaginary falsework review clock. The clock is turned on when falsework drawings are received and remains. on while the engineer is reviewing the drawings. The clock is turned off, however, whenever the drawings are being revised or corrected by the contractor. The duration of the engineer's review is numerically equal to the number of calendar days the review clock is turned on during the overall falsework review period.

Although the review period begins when a complete falsework submittal is received, the first day of the review period is the day following the day on which the submittal is received, and the final day (for a 3-week review period) is the 21st day from the day the submittal is-received, excluding any days on which the falsework review clock has been turned off.

Since the specifications contemplate a review period measured in weeks, the number of working days within the review period is irrelevant. Therefore, when calculating incremental review durations within the overall review period, the elapsed time between falsework review events is the number of calendar days between the events, including weekends and holidays, converted to calendar weeks.

Since the review clock is turned on whenever falsework drawings are received, it is essential to determine whether the drawings are complete when first submitted. This is the case because the time allowed for the engineer's review begins when the submittal is complete, but not before. Accordingly, Division policy requires an initial review immediately upon receipt of the first submittal. The time attributable to the initial review depends on whether the first submittal is found to be complete or not complete, and if not complete, on the actual time taken for the review, as explained below.

### Case I. First Submittal is Complete

The review clock is turned on when the drawings are received, and since the submittal is complete as shown by the initial review, the clock remains on until the drawings are returned to the contractor for correction and resubmission, or until the review has been completed and the drawings approved.

### Case II. First Submittal is not Complete

Although the review clock is turned on when the drawings are received, it is turned off and reset to zero following the initial review, provided the contractor is notified and the drawings returned for completion and resubmission within the

two working day period allowed for the initial review by Division of Structures policy. If, however, the initial review requires more than two days and/or the contractor is not informed that the drawings are incomplete within the two day initial review window, all additional time (beyond two working days) remains on the review clock when it is reset following the return of the drawings to the contractor.

For resubmittals following the initial review, for both the Case I and Case II situations, the review clock is turned on when the revised drawings are received and remains on while the engineer is reviewing the design for compliance with contract requirements. The clock is turned off when the contractor is informed that further changes are required, and it remains off while the contractor is making the required corrections and/or revisions. The clock is turned off for the final time when the contractor is informed that the drawings are approved. The duration of the engineer's review is the total time shown on the falsework review clock.

2-1.05B Review Time Adjustment for Design Revisions

Both the specifications and the review procedures previously discussed contemplate a scenario in which a complete falsework submittal will be acceptable as submitted, or will require only minor corrections prior to approval. While this is typically the case, situations occasionally arise wherein the contractor, following the return of drawings for correction or revision, will submit a new design rather than a corrected or revised original design. In such cases Division policy provides for an increased review time to compensate for the time previously taken to review portions of the falsework design that have been replaced or significantly altered by the new design.

Whether a resubmittal is a new design or merely a revised original design is not always clear. As a guide, Division policy provides that a resubmittal will be viewed as a new design only if the change is such as to require another design check to verify system adequacy.

For example, increasing the size or number of timber stringers to correct a bending moment overstress is not a new design, since the adequacy of the revision often can be verified by inspection, and calculations, when necessary, are elementary. However, if the resubmittal shows a longer span with steel stringers, a complete design check would be required. (That is, for the steel design it is necessary to recalculate loads, determine section properties, and verify beam adequacy by comparing actual and allowable stresses for the steel members.) The time needed to perform this second design check is added to the time originally allowed for the engineer's review to obtain an adjusted review time.

## 2-1.06 Falsework Drawing Approval

Falsework Memo No. 1 includes a comprehensive listing of items that should be considered and/or investigated before falsework drawings are approved. Prior to the approval of any falsework drawings, Falsework Memo No. 1 should be reviewed to ensure that no requirement has been overlooked.

## 2-1.06A Procedure when Railroad Company is not Involved

Except for falsework that is adjacent to or over a railroad, the falsework drawings may be approved when the structure representative is satisfied that the falsework design meets all contract requirements.

Approval will be noted on each sheet of the falsework drawings by means of an Office of Structure Construction "Plan Approval" stamp. Each sheet must be signed by the structure representative or by the member of his staff who actually reviewed the design and who is a registered civil engineer.

One set of the approved drawings will be returned to the contractor, with a cover letter signed by the structure representative.[4]

The approval letter must include the following paragraphs:

"The falsework drawings dated (date) for (Name of Structure) have been reviewed and are approved to the extent provided in Section 5-1.02 of the Standard Specifications."

"Your attention is directed to your responsibilities pursuant to Sections 5-1.02, 7-1.09 and 51-1.06 of the Standard Specifications, and to applicable requirements of the Construction Safety Orders."

"You are reminded that falsework construction must conform to the approved drawings, that the materials used must be of the quality necessary to sustain the stresses required by the falsework design, and that workmanship must be of such quality that the falsework will support the loads imposed without excessive settlement or joint take-up beyond that shown on the falsework drawings."

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[4] Under the specifications, falsework construction (except for foundation pads and piles) for any unit of the falsework may not begin until the drawings for that unit have been approved. From a contractual standpoint, the approval letter is the contractor's authorization to begin falsework construction.

Concurrently with approval, one copy of the approved drawings and one copy of the engineer's calculations are to be submitted to the Sacramento Office of Structure Construction, along with a copy of the approval letter sent to the contractor.

One set of the approved drawings and the original calculation sheets are retained in the job files.

2-1.06B Procedure when Railroad Company Approval is Required

For structures adjacent to or over railroad facilities, approval of the falsework drawings is contingent on the drawings being satisfactory to the railroad company involved.

When railroad company approval is required, the falsework drawings are first reviewed for adequacy and compliance with contract requirements in the same manner as all other falsework drawings. When the review has been completed and the structure representative is satisfied that all contract requirements have been met, the drawings are to be sent to the Sacramento Office of Structure Construction for subsequent transmittal to the railroad company, in accordance with the procedure described in this section.

The Standard Specifications include special requirements for all falsework over or adjacent to railroads. When railroads are involved, the contract special provisions will include additional requirements that are project specific. Section 10 of the special provisions will include requirements for false-work openings and collision posts, and other specific railroad requirements may be included in this section as well. The number of sets of falsework drawings to be submitted by the contractor is found in the "Railroad Relations and Insurance" section of the special provisions, along with any specific requirements for protection of railroad tracks and/or property.

Standard Specification and special provision requirements for falsework adjacent to and over railroads should be reviewed before the drawings are sent to the Sacramento office to ensure that all applicable requirements have been met.

All falsework opening clearances must be clearly shown. Note that the vertical clearance is measured from the top of the track rail and horizontal clearances are measured from the centerline of the tracks.

In most cases, only the falsework drawings for the structure span over the railroad tracks will require review and approval by the railroad company. However, when the structure is high enough for adjacent structure span falsework to fall on rail-road property, the falsework drawings for those adjacent spans must be submitted as well.

Falsework drawings that do not require review and approval by the railroad company may be approved as soon as the design check is completed. For such drawings, approval shall be in accordance with the instructions in Section 2-1.06A.

The number of copies of drawings and other data required depends on the type of structure and the railroad company involved. For the Southern Pacific, Western Pacific, and Atchison, Topeka & Santa Fe railroads, submit the following: [5]

- Four copies of the falsework drawings. (Five copies for underpass structures and the Atchison, Topeka & Santa Fe Railway.)
- Two copies of manufacturer's catalog data for manufactured assemblies. (Three copies for underpass structures and the Atchison, Topeka & Santa Fe Railway.)
- Two copies of the contractor's calculations. (Three copies for underpass structures and the Atchison, Topeka & Santa Fe Railway.)
- Two copies of the Structure Representative's calculations. (Three copies for underpass structures and the Atchison, Topeka & Santa Fe Railway.)

Note that one copy of each of the above listed items is for use by the falsework section in the Sacramento Office, and the remaining copies are forwarded to the railroad company. In the event that railroad company personnel at the job site need copies of falsework drawings or other data, they are to obtain them from their headquarters, not from the State or contractor.

Drawings and other data submitted to the Sacramento office are to be accompanied by a letter of transmittal from the structure representative listing the items submitted. The letter shall state that the drawings have been reviewed and are considered satisfactory:

Drawings and other data will be reviewed in the Sacramento Office of Structure Construction, and if complete and otherwise satisfactory, will be forwarded to the railroad company for review and approval. (Submittals which are incomplete will be returned to the structure representative.)

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[5] For other railroads, including light rail facilities consult the falsework review section in the Sacramento Office of Structure Construction for the number of copies required.

When the Sacramento Office of Structure Construction is informed by the railroad company that the drawings are satisfactory, the structure representative will be notified by telephone, with a confirming letter following. Upon notification, the structure representative may approve the drawings. Approval should follow the procedure discussed in preceding Section 2-1.06A.

It is emphasized that falsework drawings for structures over railroad facilities are not to be approved until the structure representative has been notified by the Sacramento Office of Structure Construction that the design is acceptable to the railroad company.

2-1.07 Cal-OSHA Requirements

Article 1503 of the *Construction Safety Orders* requires the contractor to obtain a permit to construct or dismantle falsework or shoring that is more than three stories high, or the equivalent height in feet. Article 1503 further defines a "story" as 12 feet; consequently, this requirement will apply to all falsework which exceeds 36 feet, measured from the top of the falsework foundation to the bridge soffit.

Obtaining the permit required pursuant to Article 503 is the contractor's responsibility. Upon application, a permit will be issued for a specific project; however, as a business practice many bridge contractors obtain a blanket permit to cover all of their work. Blanket permits must be renewed annually.

Although the structure representative has neither the authority nor the duty to enforce Article 1503, as a matter of policy the fact that the contractor has a valid permit will be verified before the falsework drawings are approved in any case where a permit is required; i.e., when the falsework is more than 36 feet high. The date of verification should be noted in the falsework log and job diary.

2-1.08 Design Revisions to Approved Drawings

The specifications contemplate the possibility of the contractor submitting a revised design after the original design has been reviewed and approved. For this occurrence, the engineer is allowed sufficient time for a review, but not more time than was originally allowed.

For administrative purposes, any revision to an approved falsework drawing will be viewed as a new submittal, and as such will be reviewed pursuant to applicable specification requirements and the review policy and procedures previously discussed herein. Division policy provides that the engineer's review be performed expeditiously.

## 2-1.09 Chronological Record of Falsework Review

A chronological record, or log, showing all pertinent dates relating to the submission, review and approval of falsework drawings is required for each structure in the contract

Normally, the first entry will be the date the drawings are first received. If, however, topics having significance with respect to the falsework design are discussed prior to the first submittal, the discussion should be noted and the log started.

The falsework log will include the date the falsework drawings were first received; the date(s) the contractor is notified of required revisions, including the reason(s) the review could not continue and/or why the drawings had to be returned; the date(s) revised drawings were received, the dates and subject matter covered in conversations and letters relating to the falsework review, the date of approval, the date the drawings were forwarded to headquarters, and any other pertinent dates affecting the review.

Keep the falsework review clock in mind when making entries in the falsework log. When entries are properly made, the time taken for the engineer's review should be readily apparent.

Make a notation in the log of the date that falsework for a given structure becomes the controlling operation on the project, and the date on which it is no longer controlling. Be specific as to the activity that is actually controlling, such as preparation of drawings by the contractor, review by the State or railroad company, falsework erection, etc.[6]

Entries in a chronological log are not in lieu of similar information shown in construction diaries. The diary entry should give detailed information, whereas the chronological log should list only the dates, identification of subject, and the people involved.

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[6] In some situations, particularly where a CPM analysis has not been made, it may be difficult to ascertain whether falsework is, or is not, on the critical path. If the actual controlling operation is **not** evident but it appears that the falsework review **(or construction)** may affect other aspects of the project, the Structure Representative should note this fact in the log.